Hence it is seen that the chemical rays reflected at different times and hours not only possess quantitative but also qualitative differences, similar to the various coloured rays of the visible spectrum. Had nature endowed us with the power of discriminating the chemical rays, as we do the visible ones, by impressions of varying colour, we should see the rosy tints of morning pass in the course of the day through all the gradations of colour until the warm evening ones at length succeed.

A long and continued series of observations must be made before we are able to appreciate the influence which these qualitative differences in the chemical rays exert upon the photochemical phenomena of vegetation. That this influence must be of the greatest importance is evident from the varying effects produced in other photochemical processes by differences in the solar light. We need only mention in proof of this assertion, the fact, well known to all photographers, that the amount of light, photometrically speaking, gives no measure for the time in which a given photochemical effect is produced, and that a less intense morning light is always preferred for the preparation of pictures to a bright evening light.

XI. "On the Causes and Phenomena of the Repulsion of Water from the Feathers of Water-Fowl and the Leaves of Plants." By George Buist, D.C.L. of Bombay, F.R.S. Received April 3, 1857.

Happening to reside in Bombay, in the neighbourhood of a number of small tanks or ponds abounding with the Lotus or sacred bean of India, and with four different varieties of Water Lily, I was struck with the different appearances presented by these when immersed in water, or when water was sprinkled on them. The leaves of the lily, like those of the Lotus, floated with considerable buoyancy on the surface, but never, like the Lotus, rose above it, on a tall independent stem. The lily leaf is full of holes about the size of a pin's head, and serrated at the edges. Through these, when the leaf is pressed down, the water perforates freely. The upper surface of the leaf is smooth and shining, and water runs off it without wetting it, as it does off a piece of glass or greased surface. When

placed under the water at an angle of about 45°, the leaf of the lily seems to change colour; the dark purple leaf of the red lily appears of a bright rich pink, the dark green or bluish-green of the white, pink, and blue lilies seem to become of a bright emerald-green; the intensity of these hues varying with the angle at which the immersed leaf is seen.

When the Lotus leaf is placed under water it reflects light like a mirror, so that the image of any object, if presented to it at a proper angle, is seen by the spectator as distinctly as if the surface were one of polished metal. When water is thrown on the surface of a floating leaf, it flows off like a pool of quicksilver, reflecting light from the whole of its lower surface; and this holds good on all occasions. The repellent property of the leaf is on the upper side only, for the lower side is always wet, being only destroyed by severe rubbing. These peculiarities seem long to have been familiar to the natives, and have given rise to the Mahratta lines in reference to the virtuous man, which may be thus translated:—

> "He is not enslaved by any lust whatever;
> By the stain of passion he is not soiled,—
> As in the water, yet unwet by the water,
> Is the Lotus leaf."

On examining carefully into the cause of this, I found the Lotus leaf covered with short microscopic papillæ, which entangle the air and establish an air-plate over the whole surface, with which in reality the water never comes in contact at all. Another peculiarity connected, but not necessarily so, so far as I could discover, with this, was the singular respiratory pores of the Lotus. The leaves of the Lotus, when full-sized, are from a foot to 16 inches in diameter; on cutting off a leaf 6 inches broad, the stalk of which was less than the third of an inch in diameter, I was able to collect 33 cubic inches of air in an hour, when the vital energies of the plant must have been injured by its mutilation; at this rate a tank covered with Lotus leaves would produce daily an atmosphere 4 feet in depth throughout its whole surface. When the leaf is pushed slightly under water, a constant succession of air-bubbles seem to arise from it, at the rate of two or three a minute at each spiracle. The air-bubble diffuses itself as it is extricated, presenting a very broad base to the leaf and blunt low-crowned apex, and seems de-

tached with difficulty. The air-plate all over the surface must thus become continually renewed and the arrangement kept perfect.

Sensible respiration is not at all essential to the repelling power of leaves; the most beautiful manifestation of it I have met with is in the *Pestia*, a little floating water-plant abounding in our shallow tanks, and resembling common endive. When pushed under the surface, it looks like a little mass of burning silver. The same appearance is presented on cabbages, young clover, and a vast variety of other leaves; it is the cause of the bright pearl-lustre of dew. The same phenomenon is manifested on the wings and backs of divers when they dash into the water. In this case it has been ascribed, most erroneously as I believe, to the presence of grease or oil in the feathers, and is, I have no doubt, due to the presence of an air-plate repelling the water, so that it never comes in contact with the feathers at all. The trimming process, so carefully performed by Water Fowl, is probably an application of oil or grease, with the object of separating or dressing the little fibres of the feathers so as to produce an arrangement fitted to entangle the air. The reflexion of light from the lower surface of the water is the proof of want of contact. A piece of polished marble or of glass, a waxed, oiled or greased surface, readily throws off the water without remaining wetted; but no reflexion is in this case observable.

Might not the manufacturers of waterproof cloth or clothes take a hint on this point from the economy of nature? Could they manage to produce a surface such as would entangle and retain a film of air, no india-rubber varnish or other water-tight material would be required, while the texture would permit the free transmission of respiration or moisture from the body, which Mackintosh's and other similar contrivances obstruct.